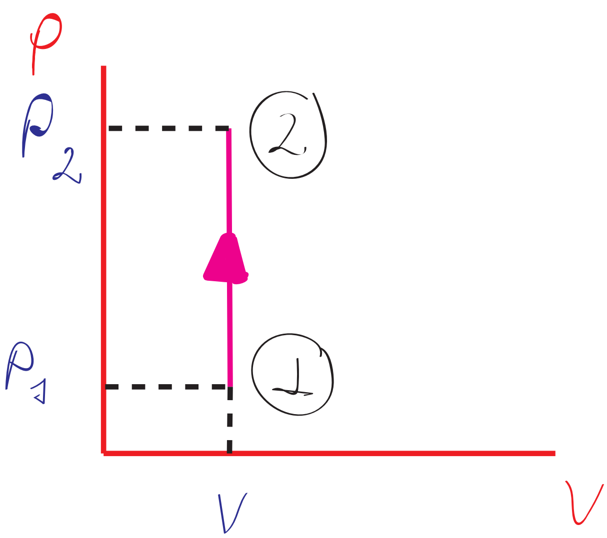
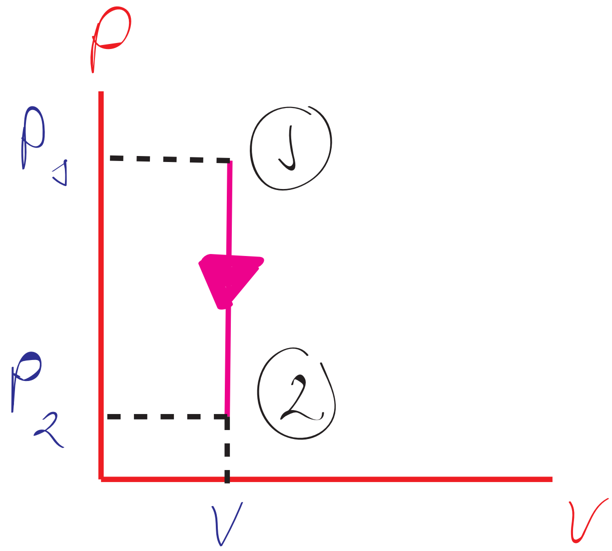
Proceso Isocorico

$V = \text{ctte}$

$W = \int P\,dV \rightarrow dV = 0$

$\boxed{W = 0}$





Gas Ideal

$PV = nRT$

donde:

$P \rightarrow$ Presion [Pa]

$V \rightarrow$ Volumen [m^3]

$n \rightarrow$ # moles [mol]

$T \rightarrow$ Temperatura [K]

$R \rightarrow$ Constante del gas $\rightarrow R = 8.314 \left[\frac{J}{mol\,°K}\right]$

Sabemos

$$PV = nRT$$

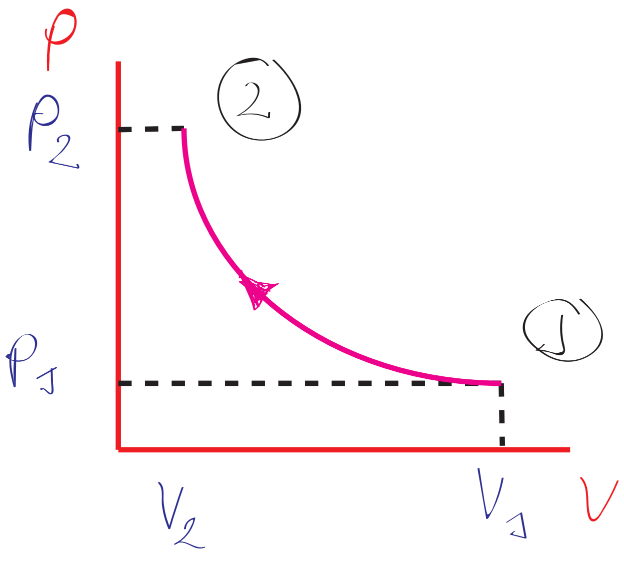
$$\frac{PV}{T} = nR = ctte$$

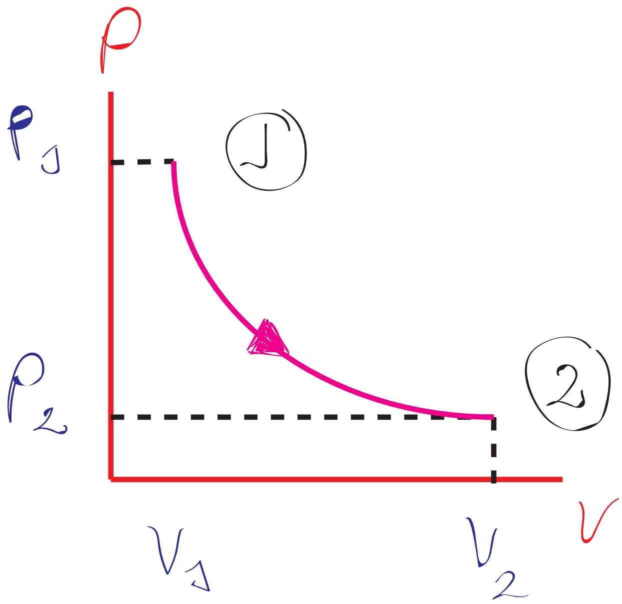
$$\frac{P_1 \cancel{V_1}}{T_1} = \frac{P_2 \cancel{V_2}}{T_2}$$

$$\boxed{\frac{P_1}{T_1} = \frac{P_2}{T_2}}$$

Proceso Isotermico

$T = ctte$





$P_2 > P_1$ $V_1 > V_2$

Gas se Comprime

$-W$

$P_1 > P_2$ $V_2 > V_1$

Gas Expande

$+W$

$$W = \int_{V_0}^{V_f} P\,dV$$

Sabemos

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

Remplazando

$$W = \int_{V_0}^{V_f} \frac{nRT}{V}\,dV$$

$$W = nRT \int_{V_0}^{V_f} \frac{1}{V}\,dV$$

$$W = nRT \ln V \Big|_{V_0}^{V_f} = nRT(\ln V_f - \ln V_0)$$

$$\boxed{W = nRT \ln\left(\frac{V_f}{V_0}\right)}$$

Gas Ideal

$$PV = nRT$$

$$\frac{P_1 V_1}{\cancel{T_1}} = \frac{P_2 V_2}{\cancel{T_2}}$$

$$\boxed{P_1 V_1 = P_2 V_2}$$

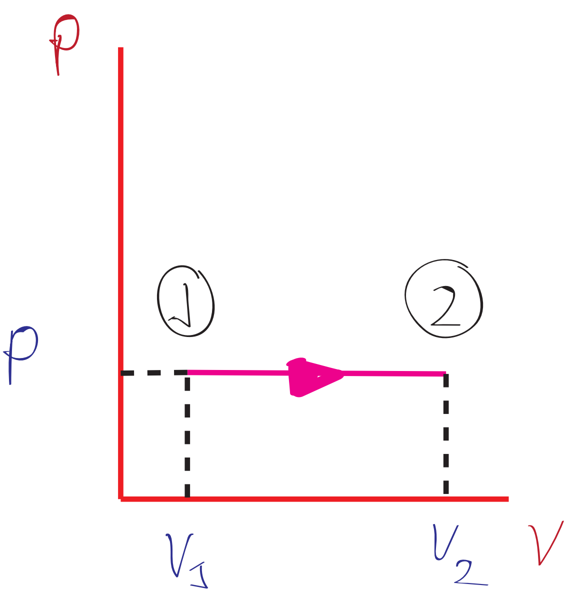
$$\frac{V_2}{V_1} = \frac{P_1}{P_2} \Longrightarrow \frac{V_f}{V_o} = \frac{P_o}{P_f}$$

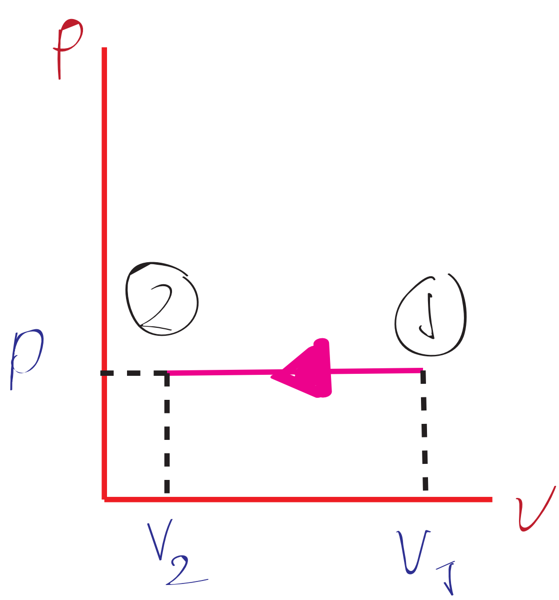
$$\boxed{W = nRT \ln\left(\frac{V_f}{V_o}\right)} \Longrightarrow \boxed{W = nRT \ln\left(\frac{P_o}{P_f}\right)}$$

$$\boxed{W = PV \ln\left(\frac{V_f}{V_o}\right)} \Longrightarrow \boxed{W = PV \ln\left(\frac{P_o}{P_f}\right)}$$

Proceso Isobarico

$$P = ctte$$





$V_2 > V_1$

Gas Expande

$+W$

$V_1 > V_2$

Gas Comprime

$-W$

$$W = \int P\, dV$$

$$W = P \int_{V_0}^{V_f} dV$$

$$W = P\, V \Big|_{V_0}^{V_f}$$

$$W = P\,(V_f - V_0)$$

$$\boxed{W = P\,\Delta V}$$

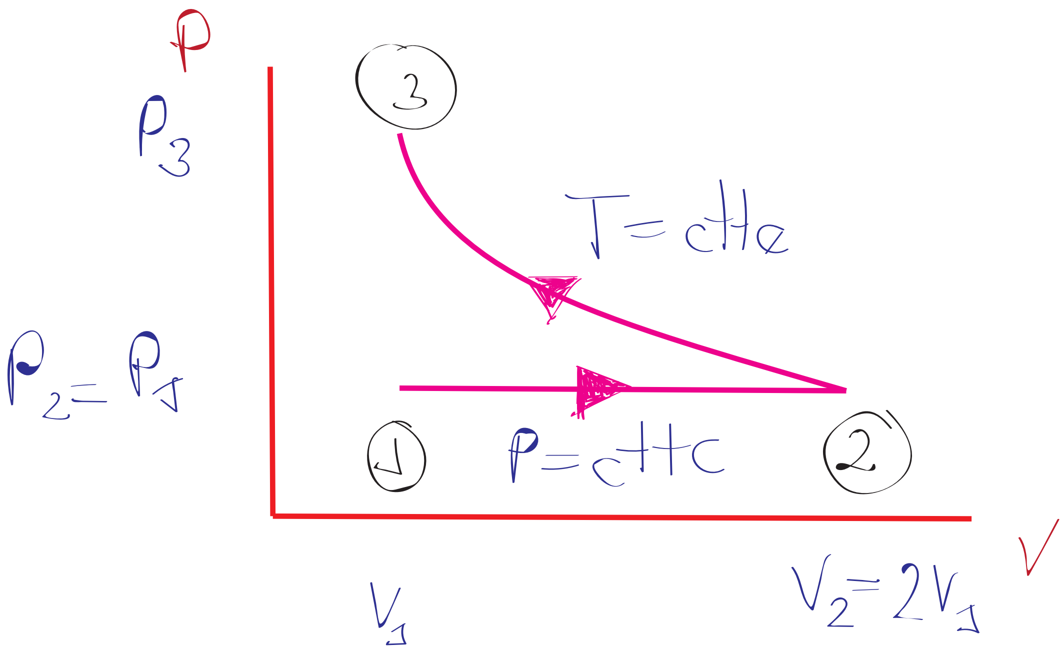
Gas Ideal

$$PV = nRT$$

$$\frac{\cancel{P_1} V_1}{T_1} = \frac{\cancel{P_2} V_2}{T_2}$$

$$\boxed{\frac{V_1}{T_1} = \frac{V_2}{T_2}}$$

4. Un cilindro con pistón contiene 0.25 moles de oxígeno a 2.40×10^5 Pa y 350 K. el oxígeno puede tratarse como gas ideal. Primero el gas se expande isobárica mente al doble de su volumen original. Después se comprime isotérmica mente hasta su volumen original. Calcule le trabajo total efectuado por el pistón sobre el gas durante la serie de procesos.



Datos

$n = 0.25\,[mol]$

$P_1 = 2.4\times10^5\,[Pa]$

$T_1 = 350\,[K]$

$$W_T = W_{12} + W_{23}$$

Desde 1 hasta 2 Isobarico

$P = ctte$

$P_1 = P_2 = 2.4\times10^5\,[Pa]$

Sabemos

$$W = P(V_f - V_o)$$

$$W_{12} = P_1(V_2 - V_1)$$

$$W_{12} = P_1(2V_1 - V_1)$$

$$W_{12} = P_1 V_1$$

Sabemos

$$PV = nRT$$

$$P_1 V_1 = nRT_1$$

Remplazando

$$W_{12} = nRT_1 \qquad \ldots \text{ec } 1$$

Calculando T_2

$$\frac{\cancel{P_1} V_1}{T_1} = \frac{\cancel{P_2} V_2}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_2 = \frac{V_2}{V_1} T_1 = \frac{2\cancel{V_1}}{\cancel{V_1}}(350) = 700\ [K]$$

Desde (2) hasta (3) Isotermico

$T_2 = ctte$

Sabemos

$$W = nRT \ln\left(\frac{V_f}{V_o}\right) = nRT \ln\left(\frac{V_3}{V_2}\right)$$

$V_3 = V_1$ Remplazando

$$W_{23} = nRT_2 \ln\left(\frac{V_1}{V_2}\right)$$

$$W_{23} = nRT_2 \ln\left(\frac{\cancel{V_1}}{2\cancel{V_1}}\right)$$

$$W_{23} = nRT_2 \ln\left(\frac{1}{2}\right) \quad \ldots \text{ec } 2$$

Remplazando

$$W_T = W_{12} + W_{23}$$

$$W_T = nRT_1 + nRT_2 \ln\left(\frac{1}{2}\right)$$

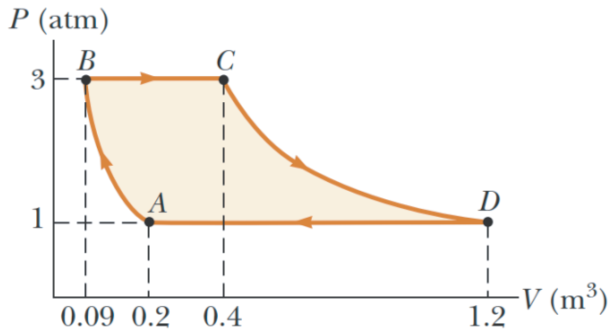
$$W_T = nR\left(T_1 + T_2 \ln\left(\frac{1}{2}\right)\right)$$

$$W_T = 0.25\,(8.314)\left(350 + 700 \ln\left(\frac{1}{2}\right)\right)$$

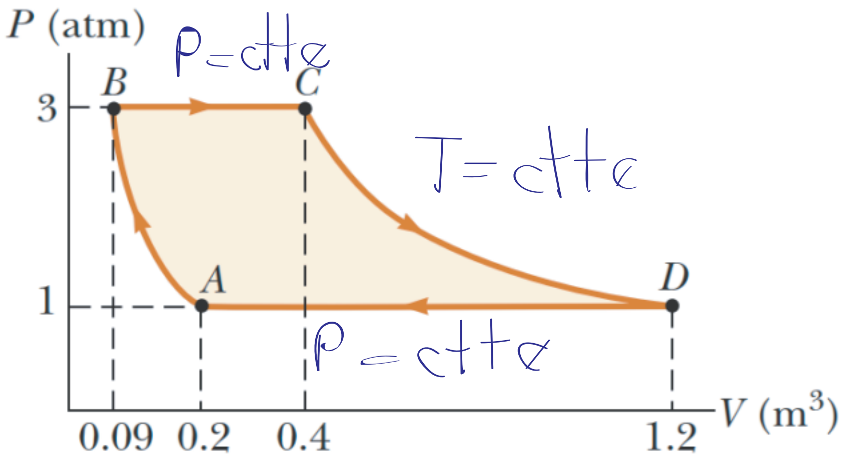
$$W_T = \left|-281\right| \,[J]$$

$$W_T = 281 \quad [J]$$

10. Una muestra de un gas ideal pasa por el proceso que se muestra en la figura P20.28. De A a B, el proceso es adiabático; de B a C, es isobárico con 100 kJ de energía que entran al sistema por calor. De C a D, el proceso es isotérmico; de D a A, es isobárico con 150 kJ de energía que salen del sistema por calor. Determine la diferencia en energía interna $U_B - U_A$.



Resp $42.9KJ$



$$U_B - U_A = \Delta U_{AB}$$

Proceso Ciclico

$$\Delta U_T = 0$$

$$\Delta U_{AB} + \Delta U_{BC} + \Delta U_{CD} + \Delta U_{DA} = 0$$

$$\Delta U_{AB} = -(\Delta U_{BC} + \Delta U_{CD} + \Delta U_{DA})$$

Proceso	Q[J]	W[J]	ΔU[J]
BC	100×10^3	94.234×10^3	5.77×10^3
CD			0
DA	-150×10^3	101.3×10^3	-48.7×10^3

De B hasta C Isobarico

$P = ctte \qquad P = 3\ atm$

$$P = 3\ \cancel{atm}\ \frac{1.013\times10^5\ Pa}{1\ \cancel{atm}} = 303.98\times10^3\ [Pa]$$

$$W = P(V_f - V_o)$$

$$W_{BC} = P(V_C - V_B)$$

$$W_{BC} = 303.98\times10^3\,(0.4 - 0.09)$$

$$W_{BC} = 94.234\times10^3\ J$$

Sabemos

$$\Delta U_{BC} = Q_{BC} - W_{BC} = 100 \times 10^{3} - 94.234 \times 10^{3}$$

$$\Delta U_{BC} = 5.77 \times 10^{3} \ [J]$$

Desde C hasta D Isotermico

$$\Delta U_{CD} = 0$$

$$Q_{CD} = W_{CD}$$

Desde D hasta A Isobarico

$$P = ctte$$

$$P = 1atm = 1.013 \times 10^{5} \ [Pa]$$

$$W_{DA} = P(V_A - V_D)$$

$$W_{DA} = 1.013 \times 10^{5} (0.2 - 1.2)$$

$$W_{DA} = -1.013 \times 10^{5} \ [J]$$

$$W_{DA} = -101.3 \times 10^{3} \, [J]$$

$$\Delta U_{DA} = Q_{DA} - W_{DA}$$

$$\Delta U_{DA} = -150 \times 10^{3} - (-101.3 \times 10^{3})$$

$$\Delta U_{DA} = -48.7 \times 10^{3} \, J$$

Remplazando

$$\Delta U_{AB} = -(\Delta U_{BC} + \cancelto{0}{\Delta U_{CD}} + \Delta U_{DA})$$

$$\Delta U_{AB} = -(5.77 \times 10^{3} - 48.7 \times 10^{3})$$

$$\Delta U_{AB} = -(-42.93 \times 10^{3})$$

$$\Delta U_{AB} = 42.93 \times 10^{3} \, [J]$$

$$\Delta U_{AB} = 42.93 \, [KJ]$$